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Philipp Gerhardt and Robert E. Marquis
(Co-Principal Investigators)

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(ES)
Department of Microbiology
Michigan State University
East Lansing, MI 48824

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13. ABSTRACT (*Maximum 200 words*)

Pursuant to the goals and objectives of the project, the following principal results were obtained: (1) the native peptidoglycan in the cortex around the dormant spore protoplast has low electrical conductivity and is highly cross-linked, contrary to results usually reported; (2) the water within the entire spore is in a free state and exchangeable by diffusion with external water; (3) hydrostatic pressure enhances the heat killing of spores; (4) the primary targets in the thermal inactivation of spores are crucial proteins of the protoplast; (5) the sporocidal mechanism of action of heat and peroxides is oxidation involving the formation of chemical radicals; (6) mineralization of spores increases their resistance to thermal inactivation; (7) polyhydroxybutyrate occurs in spores only dispersed, complexed with other biopolymers, in small amounts, and at low molecular mass; (8) a major book on basic methods for general and molecular bacteriology was edited and authored in part by the co-principal investigators; (9) claims for the revival of bacterial spores and even vegetative cells after desiccation for millions of years within amber were assessed.

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MECHANISMS OF RESISTANCE IN MICROBIAL SPORES
Final Report, 2 March 1998

Philipp Gerhardt
Department of Microbiology
Michigan State University
East Lansing, MI 48824

Robert E. Marquis
Department of Microbiology
University of Rochester
Rochester, NY 14642

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1. GOALS AND OBJECTIVES

The long-range goals of the project were to identify and explain the physicochemical determinants and physiological mechanisms accounting for heat resistance and the targets and mechanisms accounting for thermal inactivation of dormant bacterial spores.

The specific objectives for the 8¼-year duration of the project were to investigate quantitatively the following problems on sporal heat resistance:

1. Molecular characterization of the cortical peptidoglycan of dormant bacterial spores;
2. Water states within spore structures;
3. Hydrostatic pressure as an adjuvant in heat killing of spores;
4. Sequence of structural and molecular targets of irreversible thermal inactivation of spores;
5. Oxidation as a molecular mechanism in heat and peroxide killing of spores;
6. Mineralization of spores as a factor in thermal inactivation;
7. Re-assessment of the occurrence of polyhydroxybutyrate in spores;
8. Preparation of a book on basic methods for general and molecular bacteriology, including spores;
9. Assessment of claims for the revival of bacterial spores after desiccation for millions of years within amber.

2. SUMMARY/ABSTRACT OF RESULTS

Pursuant to the goals and objectives of the project, the following principal results were obtained: (1) the native peptidoglycan in the cortex around the dormant spore protoplast has low electrical conductivity and is highly cross-linked, contrary to results usually reported; (2) the water within the entire spore is in a free state and exchangeable by diffusion with external water; (3) hydrostatic pressure enhances the heat killing of spores; (4) the primary targets in the thermal inactivation of spores are crucial proteins of the protoplast; (5) the sporocidal mechanism of action of heat and peroxides is oxidation involving the formation of chemical radicals; (6) mineralization of spores increases their resistance to thermal inactivation; (7) polyhydroxybutyrate occurs in spores only dispersed, complexed with other biopolymers, in small amounts, and at low molecular mass; (8) a major book on basic methods for general and molecular bacteriology was edited and authored in part by the co-principal investigators; (9) claims for the revival of bacterial spores and even vegetative cells after desiccation for millions of years within amber were assessed.

3. LIST OF PRIMARY PUBLICATIONS

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Belliveau, B. H., T. C. Beaman, H. S. Pankratz, and P. Gerhardt. 1992. Heat killing of bacterial spores analyzed by differential scanning calorimetry. J. Bacteriol. 174:4463-4474.

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4. LIST OF PERSONNEL

4.1. AT UNIVERSITY OF ROCHESTER

Robert E. Marquis
Soon Young Shin (accomplished postdoctoral training)
Jimmy Sim (earned B.S. degree)
Glen C. Rutherford (pursuing M.S. degree)
Michelle Faraci (earned B.A. degree)
Alfredo Palop (accomplished postdoctoral training)

4.2. AT MICHIGAN STATE UNIVERSITY

Philipp Gerhardt
Brian Belliveau (accomplished postdoctoral training)
Teofila C. Beaman
H. Stuart Pankratz
Rosetta N. Reusch
Ruiping Huang (accomplished postdoctoral training)

5. INVENTIONS

No inventions from this project were applied for or received.